C-5

POKREFKE

MODEL SLOPE/DATUM

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From: Gaines, Roger A MVM
Sent: Saturday, August 24, 2002 12:54 PM
To: Pokrefke, Thomas J ERDC-CHL-MS
Subject: model supplementary slope and datum

Tom,

I've continued thinking about our discussions on model slope, model datum, and vertical scale. I know we've talked quite a bit on this and I don't want to belabor an issue, but please bear with me in trying to understand these concepts relative to the coal-bed models.

I've been studying Franco's 1978 report on model design guidelines, specifically the slope and supplemental slope sections. It seems to me from his descriptions that supplemental slope is required in different amounts depending on the reach geometry and that in some cases adjustments were made in the rails locally (section 30 of Franco, 1978 mentions this). He also mentions something about (last sentence) "unless the rails are also adjusted there will be a difference in the true bed elevation and that indicated by sounding from the unadjusted rails. " That statement seems confusing to me because we talked about supplemental slope not resulting in a change in datum and this seems to suggest that there is a "true" bed elevation and a "measured" bed elevation that results because of the rails being adjusted. I thought I had this when thinking of adjusting the rails to account for sediment mobility (downstream flattened to decrease velocity and upstream steepened to increase velocity), but now I'm lost.

If this says that there is a true and measured bed elevation, then I'm interpreting this to mean that the datum is changed. The best way I could look at this was to sketch it out. The attached has the sketch and some further thoughts.

slope-issues.doc

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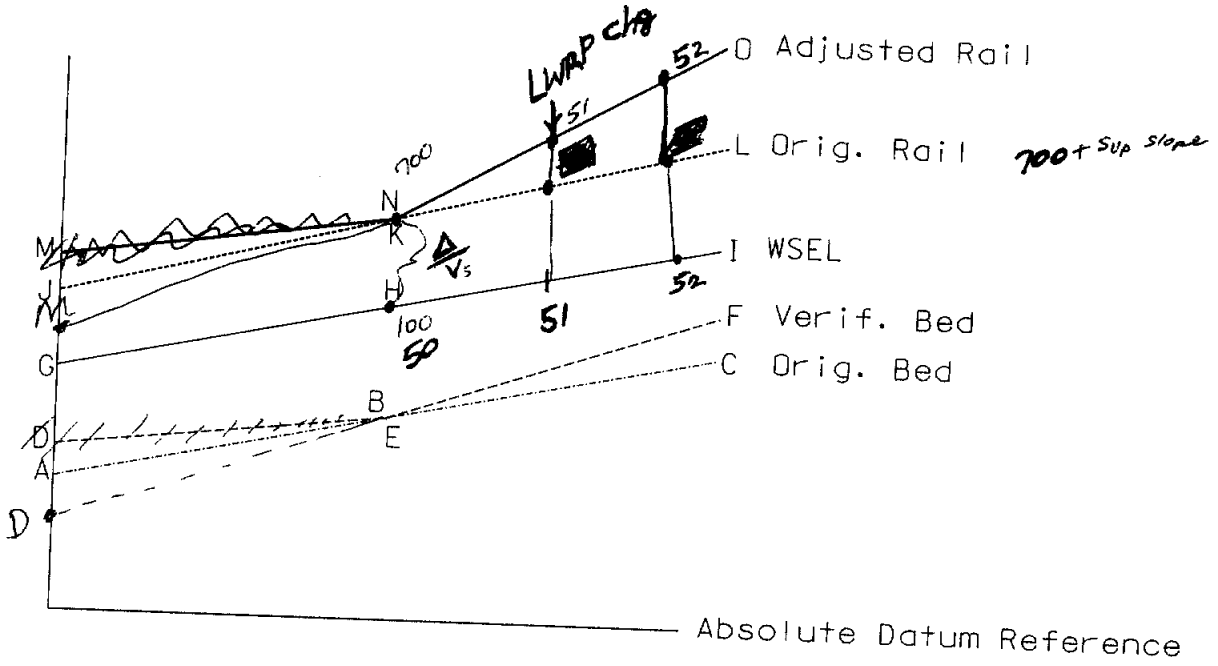

ABC = Original Bed Position

DEF = Adjusted Bed (Verification effort)

GHI = WSEL for a given discharge -- does not change for rail adjustments

JKL = Original Rail position

MNO = Adjusted Rail Position

Initially, sediment movement between JK is too high and between KL is too low. Therefore, raise the rail position at O to increase velocity in upper part of model to increase bed slope; also raise the rail position in lower part of model to decrease velocity by decreasing bed slope.

This works because the WSEL remains "constant." Question: How can the WSEL remain a constant LWRP elevation (relative to the rail) if the rail position changes? I can see the absolute elevation (based on the absolute datum shown at the bottom) of the WSEL remaining constant provided the rail adjustment is not too great, but not if the rail defines the datum. If the rail is the datum, then the WSEL must also change. If only the mid-point is used to define the WSEL, then is any of the above true (does the WSEL remain unchanged)? Ultimately, what slope is used in the model?

In the prototype, the LWRP slope varies depending on location (because it is defined by a 97% duration WSEL which is a function of geometry and conveyance of the local -- i.e. the hydraulic-radius and velocity relationship mentioned by Franco (1978) on pg. 20).

However, this WSEL is determined based upon an absolute elevation. If the LWRP were arbitrarily changed without physically changing the WSEL, wouldn't the resulting LWRP effectively change the reference datum for the bed but not for the WSEL?

For adjusting the rails as you described Thursday, it would seem that the WSEL is held as the datum and not the rails. Otherwise, the numeric value of the WSEL would be a function of the rails and based on the "elevation numbers" wouldn't achieve the adjustment of velocity desired. You might physically see the changes, I'm not sure. I'm just a little lost in how I read Franco's (1978) description of the determination and use of supplemental slope and rail adjustments and how I thought I understood you to describe the supplemental slope.

I am also trying to reconcile how this relates to the micromodel.

In micromodeling, the slope is fixed and is "parallel" to the equilibrium bed slope. The shift is simply a measure to transfer coordinates referenced to the top of the insert to an approximate LWRP elev. -- I say approximate because micromodels use only one slope and the LWRP has a variable slope. Prior to using the shift, there is no datum established for the converted model coordinates. Think of this like the HI in running a level circuit in surveying. If a point on the insert top had an established elevation which could serve as a benchmark, then model bed elevations at every point would be some distance below this benchmark elevation. The LWRP elevation(s) would likewise be some distance below this benchmark elevation. However, there is no benchmark elevation established for the insert, we only know the distance between the bed and the insert surface. In essence, we have to back-in to the benchmark elevation by selection of an HI distance--this is the shift. This HI distance cannot be determined from the model alone, because there are no references between model and prototype elevations at this point. All we have are measurements in the model. What we need is an approximate distance between the prototype bed and what the hypothetical insert elevation would be in prototype numbers. Ideally, the differences would be determined for each and every point, if the model exactly reproduced the prototype. Such is not the case so this distance is approximated between "a" LWRP elevation and the hypothetical insert elevation (in prototype coordinates). The realworld LWRP elevations and the distance to the hypothetical insert elevation are dependent on the vertical scale which is initially unknown. The vertical scale is determined by a series of successive approximations where the converted model elevations are assessed against the prototype elevations by the modeler. Because both vertical scale and the shift are used in converting model data to prototype scale, it may seem like there is an arbitrary adjustment in datum. This may only be partially true, because the shift relates the LWRP to the insert surface and only a single LWRP value is represented. Because this is an approximation, it can (and often is) better in some areas than it is in other areas of the model.

Do you see the vertical scale selection as part of the model process more an issue or is the primary issue the shift? Maybe both?